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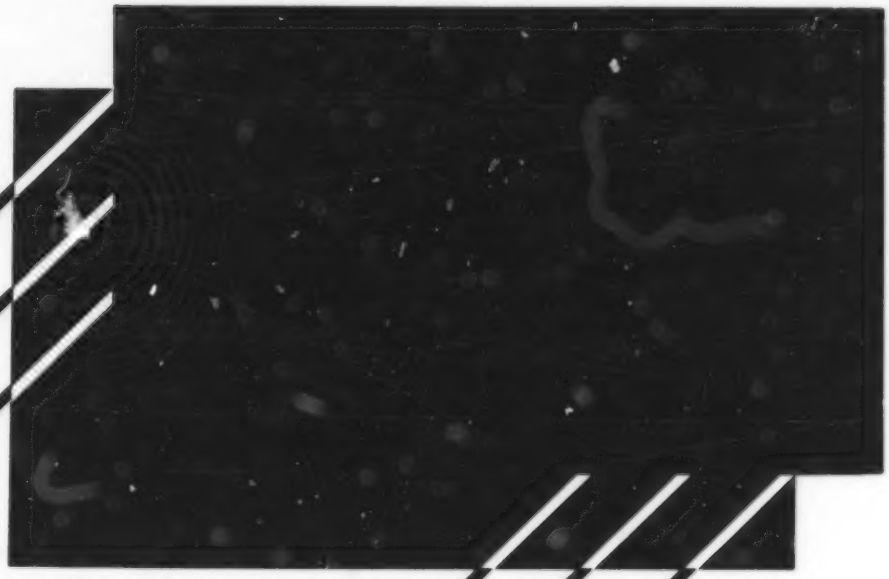

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Department of Communications of Canada
Canadian Workplace Automation Research Centre
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Information Technologies: business adaptability and free trade

by

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ABSTRACT

The movement to free trade comes at a time when progress in information technologies is in an acceleration phase. With increased integration of the Canadian and American markets, penetration of information technologies will continue at a steady pace over the coming years. To date, these technologies have been adopted by the various sectors of the Canadian economy at varying rates. This phenomenon suggests that Canadian businesses fall into two categories: modern companies ready to tackle the competition and those that have not yet made the switch to technology. The second wave of the telematic revolution is now underway in the more dynamic sectors, resulting in a pronounced improvement in productivity. While free trade will push multinational corporations to use information technologies to link up their North American operations, smaller businesses must develop strategies that will enable them to modernize more quickly. These adjustments will speed up the structural changes we have been seeing in recent years as regards job structure, production equipment and the nature of transactions between companies. In Quebec, where information technologies are penetrating more slowly, these adjustments must be paired with appropriate economic policies on human capital, research and development and access to venture capital.

Key words: information technologies, free trade, telematic revolution

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I. OVERVIEW

Three elements of the Free Trade Agreement are of prime importance for strategic planning by business:

- Free movement of products as a result of the gradual disappearance of tariffs and the elimination of certain barriers to trade in goods and services.

- Much easier movement of capital: Americans will be able to invest more freely in new businesses in Canada, and these companies will receive the same treatment as Canadian companies. Purchases of existing companies will be simplified, although ceilings will remain and some sectors of the Canadian economy are excluded from the agreement. Canadians will be able to invest freely in the U.S.

- Free movement of information between the two countries is guaranteed by the section of the agreement on services. This clause eliminates any obstacles to the movement of information stored on computer through advanced communication systems.

These three elements of the agreement will accentuate the integration of the two economies and clearly increase competition in the marketplace.

The effect of this over the coming years will be a further acceleration of the technological progress that began during the 1970s and has increased

in pace since the current expansion phase began in 1983. Penetration of information technologies in particular will continue under the pressure of more integrated and more competitive markets.

As regards large multinational corporations, which in general already use information technologies, the Free Trade Agreement will enable them to plan their operations on a North American scale and thus realize productivity gains. Specialization among the subsidiaries of such corporations has already been observed, but the free movement of information guaranteed by the Agreement will also permit the increasing use of information as a factor of production. This will call for investment in information capital and will be accompanied by changes in the job structure of companies.

In small business, penetration of information technologies varies considerably from one sector to another, and major variations have been noted between companies in the same sector. When we look at the small amount of data available on this question, there seems to be a certain division between companies. The more dynamic are in general already using information technologies to varying degrees. The use of these technologies decreases with the size of the business, and in small companies the use of telematics tends to be limited to simple operations. In order to survive in a more competitive environment and profit from the market advantages offered by free trade, these companies must invest increasing amounts in new technologies. There are certain obstacles to this

needed effort, which we will analyse further on. For the moment, let us mention two major problems:

- Managers and workers do not always have the qualifications necessary to assess the technological needs of the organization and use new technologies. This is also why there is growing concern about the quality of human capital both in Quebec and in Canada.

- As well, a sufficient pool of venture capital must be available to invest in new technologies.

II. INFORMATION TECHNOLOGY, PRODUCTIVITY AND FREE TRADE

The rationalization of Canadian business (specialization, production on a larger scale, etc.) in response to free trade occurs at a time when the development of micro-electronics is resulting in a new wave of technical progress. The Canadian economy will thus be hit by a twofold shock:

- One is linked to access to a vast market and Canada-U.S. rationalization of production organization. It should be noted that, before the signing of the Free Trade Agreement, some companies had already begun this rationalization exercise. The automobile industry had done this through the Auto-Pact and, more recently, Canadian subsidiaries were given global export mandates in a context of increasingly world-scale trade.

- The other, the effects of which are already being felt, is associated with accelerated development of information technologies.

It is this latter aspect that we will examine in more detail. The development of micro-electronics and its applications to robotics, office automation and communications are currently changing the structure of the economy. The implications are numerous, and have to do with:

- productive **capital make-up** (whereby information capital is increasingly replacing traditional equipment);

- **job structure** (workers are increasingly involved in information-related occupations);

- the **links** between companies and the various sectors of the economy (whereby information becomes a sophisticated input element traded between various industries).

To better appreciate the effects of this technological advance, we can look at several aspects of recent information technology development in Canada, with reference to our ongoing research[1] on the information sector in Canada and to various other studies.

• The importance of information

We should first underline the importance of information in the economy, both as a factor of production and as a consumer good. Based on the characteristics of jobs in Canada, we calculated that in 1986 approximately 50% of Canadian workers had as their main responsibility the collection, handling, transformation and diffusion of information. In other words, about half of Canada's production was information. This is a good indication of the present importance of information and the various technologies that enable it to be used as a production factor or offered as a consumer good.

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[1] See Yves Rabeau. *L'économie de l'information au Canada : une approche entrée-sortie*, Laval : CWARC, december 1989.

• Relation between productivity and information technology

The close link that exists between productivity and information technology has been demonstrated in practice for all sectors of the Canadian economy. When the production of information workers is higher than average, productivity (production per worker) is generally higher than average. This observation corresponds to those of other studies (Economic Council of Canada, 1986) and, looking specifically at Quebec, a study by L. Lefebvre *et al.* (1986) indicates that managers feel that the use of information technologies increases the productivity of their organizations.

The impact on productivity varies, however, from one sector to another. Productivity gains are particularly high in the resource sectors, including the energy sector. They are also high in the manufacturing sector, although there is considerable variance between industries. The most significant productivity gains in fact occur in those sectors dominated by large corporations. In such cases, the use of information technology is widespread and impacts on a number of the organization's operations (production, stock management, office work, etc.). In the service industries, productivity gains are less pronounced, and it is difficult to see an overall trend.

Use of information technology in a number of service industries is still in the learning stage, and the real productivity gains will only become evident several years down the line.

In Quebec, our observations were confirmed at least in part by the study mentioned above (L. Lefebvre et al., 1986). According to this study, the larger the company, the higher the productivity gains related to the use of information technology and resulting in a reduction in jobs per unit produced. However, the study does not provide information indicating a link between technological impact and sector of activity.

- **Companies produce an increasing share of the information they use**

Our study also showed that much of the information used as a factor of production is produced by the very sector that uses it. This is a major change from the previous decade. Beginning in the 1980s, the comparatively faster development of micro-computers, their relatively low cost and easier access compared to previous generations of computers resulted in many organizations taking back a number of operations they had subcontracted out to specialized companies in the business service sector. These companies are now moving away from computer services and instead are setting up computer systems for business, developing software to assist with problems of computer utilization, etc. Companies are thus exchanging information that is ever more sophisticated in content. It should be noted that this major change also affects the use of systems for communicating information.

With the use of fax machines, for example, companies can themselves have the means of sending information directly while limiting their need for intermediary services to a simple telephone line. Messenger services are currently being partly replaced by electronic information transfer.

The transformation we described in our study should become more marked in the coming years since micro-computers are becoming increasingly accessible and generally have a positive effect on productivity. Increased competition with the United States will no doubt create pressure in this direction. Such a trend will pose a challenge, in particular with respect to human resources. Companies will have to hire new information workers, or enable their present workers to acquire the knowledge needed to use new technologies efficiently. In this connection, we might mention a new trend in the labour market: a growing proportion of the jobs created are filled by highly qualified workers, who are generally information workers. Since there is a shortage of such workers on the market, companies will have to invest increasing amounts in the training of their human resources by means of their own training programs. Japan is already well advanced in this field, and the United States, faced with this competition, have begun to catch up with them (Scientific American, June 1989). Canada will have no choice but to follow. Here Quebec, with fewer large corporations, which tend to make greatest training effort, is particularly vulnerable, since the proportion of Quebec companies involved in training (14%) is well below that of Canada as a whole (25%).[2]

The growing presence of information technology also shows the **strategic importance** of the business services sector. As mentioned, this sector has

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[2] See *État de situation sur la formation de la main-d'oeuvre au Québec*, Direction des politiques et des programmes de main-d'oeuvre, Ministère de la main-d'oeuvre et de la Sécurité du revenu, Gouvernement du Québec, July 1989.

changed the composition of services sold to other businesses over the past few years. The services offered have become more complex and have to do with the development of sophisticated computer systems tailored to fit the needs of customers. This consultant sector must also guide companies in their choice of a technology portfolio, equipment purchases and so on.

In this regard, it is no coincidence that studies on free trade (Magun *et al.*, 1988) forecast significant development in this sector. Here again, development of the business services sector will create a need for qualified graduates.

• The second wave of the information technology revolution

In the earlier trend observed, the introduction of information technology into organizations resulted in a steady increase in the number of information workers from 1971 to 1986. In general, this trend has become more pronounced since 1981, although not to the same extent from one sector to another. This uneven growth has also been confirmed by a Statistics Canada study on the use of technology. On a regional basis, Quebec is generally behind Ontario, with 45% of manufacturing establishments in Quebec using at least one advanced technology application compared to 57% in Ontario.[3] This situation reflects in particular the sectorial make-up of the Quebec economy, as well as the

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[3] See *Survey of Manufacturing Technology*, June 1987 : final report, Statistics Canada, 1987.

greater proportion of small businesses. It may also reflect other factors such as the dynamism of business owners, access to capital markets, etc.

The inequality between sectors has become more pronounced since 1981. While the fundamental trend of increasing numbers of information workers has continued in many sectors, a new trend has appeared in some of the more dynamic sectors: from 1981 to 1986, production in these sectors has increased appreciably, but the real number of information workers and even the proportion of such workers in the labour force **has declined**. This has meant exceptionally high gains in worker productivity.

We are thus now looking at what might be called the second wave of information technology penetration. The introduction of ever more sophisticated technology has resulted in a new generation of information workers replacing the first. New technologies are in fact radically changing the structure of jobs and the way companies function:

- Since the early 1980s, there has been a major reduction in the number of middle managers, who were the product of the first wave of information technology. The use of micro-computers has given senior management direct access to the information they need to direct operations. As well, progress in computer technology has caused a reduction in the entire support-staff bureaucracy.

- CAD/CAM techniques and robotics also tend to reduce the number of plant workers and workers in supervisory and quality-control

jobs. The replacement of inventories by information has also reduced the requirement for stock management employees.

All these job losses have benefited the professionals involved in various aspects of information technology; employment of these workers has skyrocketed since the current expansion phase began in 1983. It should be noted that, at the time an organization begins modernizing, there may be a net decrease in jobs, reflecting major productivity gains. The transport equipment sector in Canada has been a striking example of this. But, in the medium term, innovative companies are often those whose sales rise the fastest (G. Betcherman and R. McMullen, 1986), so that market growth may compensate for the impact of technological progress on employment.

These trends have also been observed in general in Quebec (L.A. Lefebvre *et al.*, 1986), although the effects of the second wave of the telematic revolution do not yet appear to have reached a significant number of organizations. The above-mentioned study mentions a decrease in the employment of more traditional workers and an increase in professionals linked to information technology. But the major decrease in employment associated with the use of new technologies seen in certain sectors elsewhere in Canada has not yet occurred here (L.A. Lefebvre *et al.*, 1986; L.A. Lefebvre and E. Lefebvre, 1987).

III. THE SECOND TELEMATIC REVOLUTION AND FREE TRADE

The second wave of the telematic revolution should gain strength in a climate of free trade. Free movement of information, products and, to some extent, services will allow large corporations in particular to plan their operations on a North American scale. All financial control operations could be handled by one unit at the head office. From a centre collecting information on sales, stocks could be controlled and the entire production of various specialized plants across the continent could be planned. This very high degree of information use is already occurring in the U.S., and competition will cause it to be extended to the whole Canada-U.S. economy.

This change as a result of integration of the two economies and the acceleration of progress in information technology may lead, at least during a certain adjustment period, to a sort of split in the Canadian economy, as already manifested by the varying degree of use of new technologies in different industries (L. Osberg, N. Wolff, W.J. Baumol, 1989). On the one hand, there will be highly modern companies forming part of a whole North American communication network and, on the other, smaller organizations using information technology to a lesser degree and linked up to more limited regional communication networks.

From this standpoint, a certain split between companies using information technology and those that have not yet adopted modern technology seems to be emerging in Quebec (L.A. Lefebvre and E. Lefebvre, 1987). Companies that are most in favour of free trade and the entire question of

integrating the Canadian and American economies are those that are already using information technology. Those that are not in favour and potentially fear the effects of free markets are those that have not yet modernized their operations.

Various strategies can be developed to deal with this trend, some examples of which follow:[4]

- Company mergers or associations could be one way of achieving the size needed for easier access to information technology.

- Specializing in export areas would enable businesses to use leading-edge technology and be in contact with the entire North American market and, eventually, the world market.

- Sub-contracting to large North American corporations might provide access to their technological resources and result in technology transfer agreements.

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4 In this study, we do not take into maccount strategies for the marketing of goods and services on the North American market; this is an important aspect of business strategy that lies beyond the scope of our analysis, which concentrates on the technology aspects. For the marketing aspect, see Yves Rabeau, «Macro-écononie du libre-échange : impacts et opinions», *Revue internationale de gestion*, May 1988.

IV. THE COMPETITIVE CHALLENGE

We have seen that, from the first year the free trade agreement was in effect, various companies in both Canada and Quebec adopted one of these strategies. There have already been several major mergers, and companies have invested considerable amounts over the past two years in modernizing their productive equipment. These adjustments will continue over the coming years, but application of such strategies may well be hampered by various chronic weaknesses in the Quebec economy which will slow down the adjustment process:

- Here again, we must stress the shortage of qualified workers in Quebec. In this connection, the rate of vacant positions has increased over the past two years, while the unemployment rate has declined marginally and salary growth has quickened. Companies cannot find the workers they need. This is a major problem, one that companies alone cannot remedy by investing in training programs. It is a problem of the formal education system and government training and retraining programs for workers. Countries that have economic policies in favour of introducing new technologies must also invest in their human capital. We have seen that the development of a sector specializing in business services in leading-edge technology is crucially dependent on the human resources available. Under free trade, increasing investment in education, and in particular in higher education, thus becomes vital for the Quebec economy.

- Moreover, we feel that corrective action must also be taken with respect to training workers already active in the labour force. Since the company is often best placed to judge its personnel requirements, government intervention should increasingly be in the area of cost-sharing, while leaving it up to the organization to find the resources to train its personnel. Quebec government policy, according to the last budget speech, appears to be going in this direction, while that of the federal government (with the reform of the unemployment insurance program) seems instead to favour the bureaucratic approach. There thus remains a problem of federal-provincial coordination in this area.

- The chronic weakness of R & D activities in Quebec is another obstacle. This problem is inevitably linked to the question of the quality of human capital in Quebec. Here we refer not only to the availability of researchers and professionals, but also to the quality research on products, technologies, etc. Quebec's weakness in R & D is also due to such things as poor access to venture capital, very inadequate cooperation between the public and private sectors, under-funding of universities and the lack of close ties between universities and business. Efforts have been made in these areas, but not yet to any great extent. Then too, channeling public and private savings into R & D is not enough; we must develop information networks, put interested parties in contact and, in short, develop a whole R & D culture as has been done in other countries.

- The problem of access to available capital remains an obstacle to the modernization of smaller businesses. The QSSP program for a time provided a means for increasing the supply of venture capital in Quebec, but the operation of the stock market has shown that it is not possible to develop a venture capital market on the basis of tax benefits alone. Increased use of bank lines of credit as a means of financing by Quebec companies since the collapse of the QSSP market is a good illustration of the problem of access to a venture capital pool. This is a financial intermediary problem which should gradually be resolved as a result of competition between financial institutions.

V. CONCLUSION

The highlights of this presentation may be summed up as follows:

- free trade has come at a time when progress in information technology is accelerating. As a result of increased integration of the Canadian and U.S. markets, information technology will penetrate at a sustained rate over the coming years. The second wave of the telematic revolution is now underway, and is tending to significantly increase the productivity of information technologies.

- these technologies are being adopted at different rates in both Canada and Quebec. On the whole, Quebec seems to be behind the rest of Canada. The varying degree of adoption indicates a certain split between companies, some of which are already modernized and ready to face increased competition, while others have not yet begun using this technology.

- free trade will lead multinational corporations to use information technology to integrate their operations on a North American scale, allowing them to achieve considerable productivity gains. Smaller companies must develop a strategy to enable them to modernize faster and take advantage of the market expansion associated with free trade.

- these adjustments will speed up the structural changes we have been seeing over the past few years in the composition of jobs and production equipment and in the nature of transfers between companies. In Quebec, these adjustments, and in particular the growing use of information technology in companies, should be paired with appropriate economic policies on investment in human capital, research and development and access to venture capital.

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